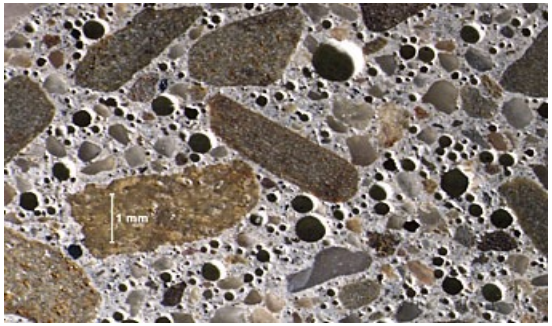
Fly Ash Supply and Quality.

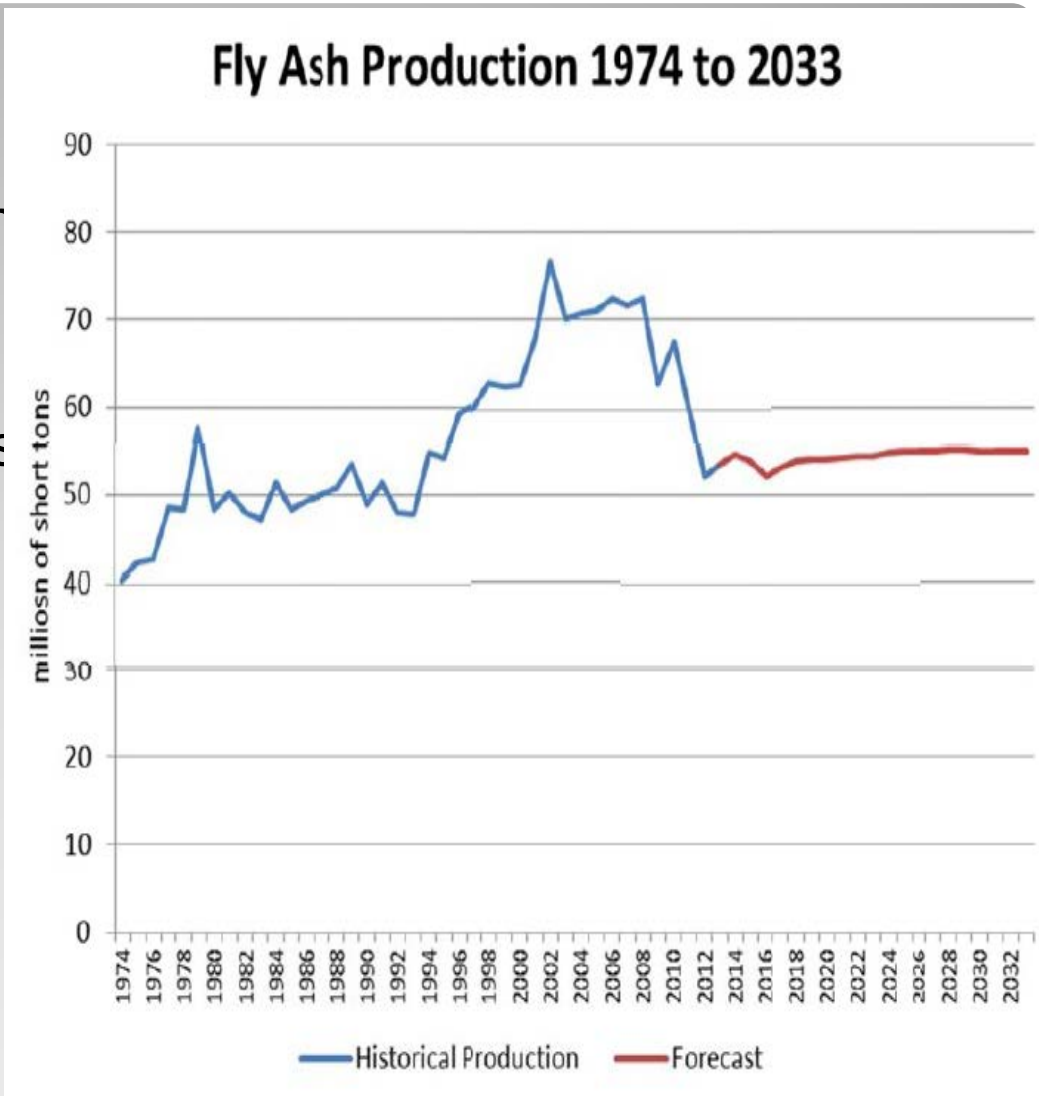


NCC RENO meeting, 4/20/ 2015

“The Reports of my death are greatly exaggerated!”

Samuel Langhorne Clemons (Mark Twain) June 1897

- New study by American Road & Transportation Builders Association will forecast continued fly ash production greater than 50 million tons annually
- Current fly ash utilization is 23.3 million tons annually; 43.7 percent of production



Fly Ash Availability Mirrors Coal Consumption

SOURCE: American Road & Transportation Builders Association, 2015

Industry Challenges

- During the last 5 years: The concrete industry consumed ~20% of the fly ash produced in US.
- Another 25% was beneficially used in lesser value markets.
- The remaining 45% was disposed in landfills and wet impoundments

- Low natural gas prices and pollution control regulations are resulting in some coal-fired plant closures, changing dispatch and emissions testing is impacting seasonal and regional supplies

- Wet Scrubber (Wet FGD) 80% reduction in SO2.
- Dry Scrubber (Dry FGD) 90+% reduction in SO2
- Dry Sorbent Injection (Trona) 40-75% reduction in SO2
- Selective Non Catalytic Reduction (SNCR) 35% reduction in NOx (Ammonia)
- Selective Catalytic Reduction (SCR) 90% reduction in NOx (Ammonia)
- Powdered Activated Carbon (PAC) 90% mercury removal

Emissions Terminology

Impacts to Concrete quality

- Trona: Raises alkalis. May effect set times
- Ammonia: Health concern, no issue with Concrete.
- PAC: May create entrained air issues, depending on PAC used.

- All create use issues and may cause the material to be out of spec or to be removed from the market.
- Plant testing for emissions controls, (1 week- 3 months)

2015 deadline

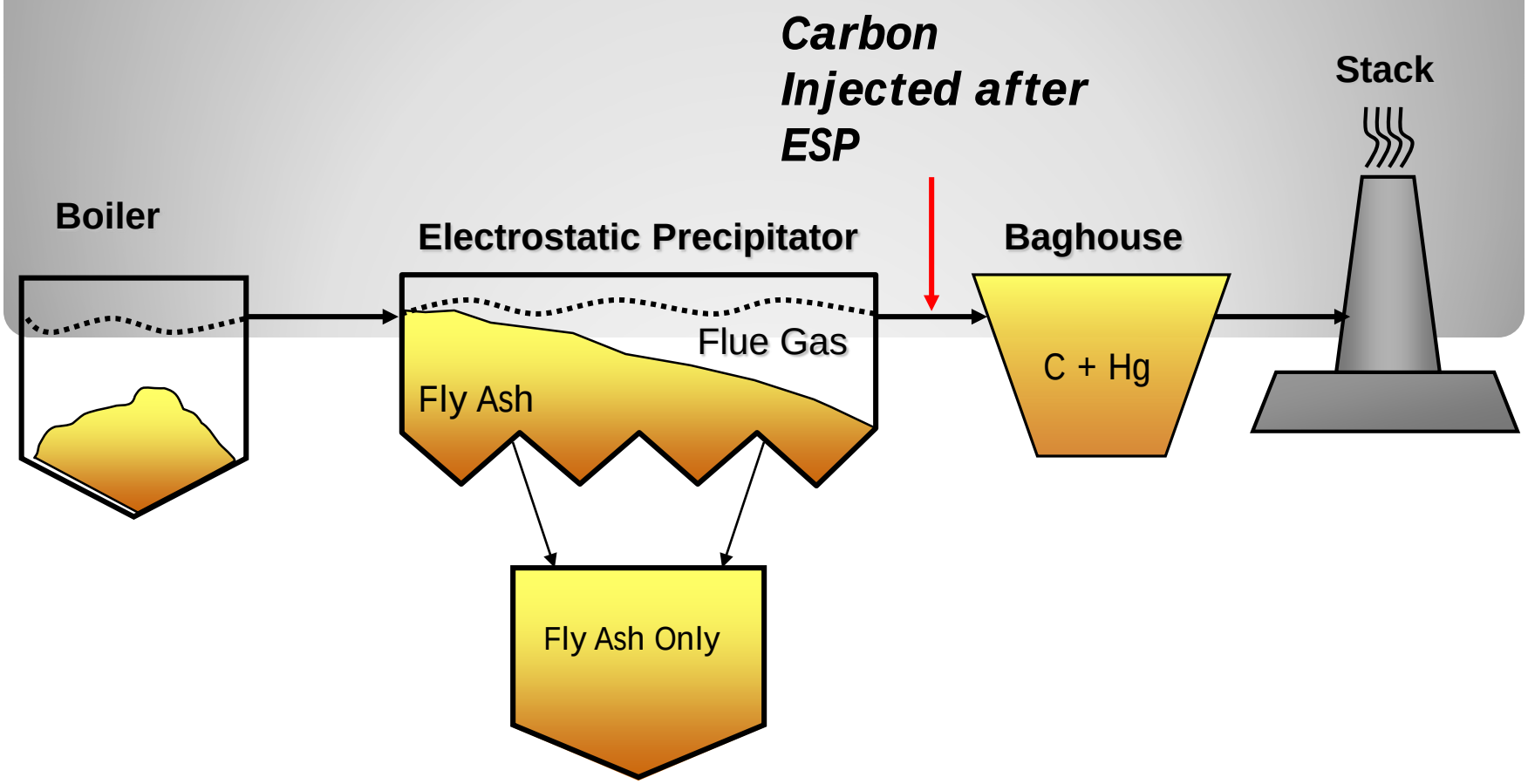
Mercury and Air Toxics Standards (MATS) final rule went into effect in December 2011 requiring coal fired power plants to control mercury emissions within 3 years (April 2015):

- States may grant 4th year (2016)
- USEPA administrative order would allow 5th year (2017) for critical units.

Powdered Activated Carbon (PAC) injection is the primary control technology for mercury.

Fuel change, wet scrubber w/ additives and other options might be available.

Activated Carbon Injection
Post Fly Ash Collection



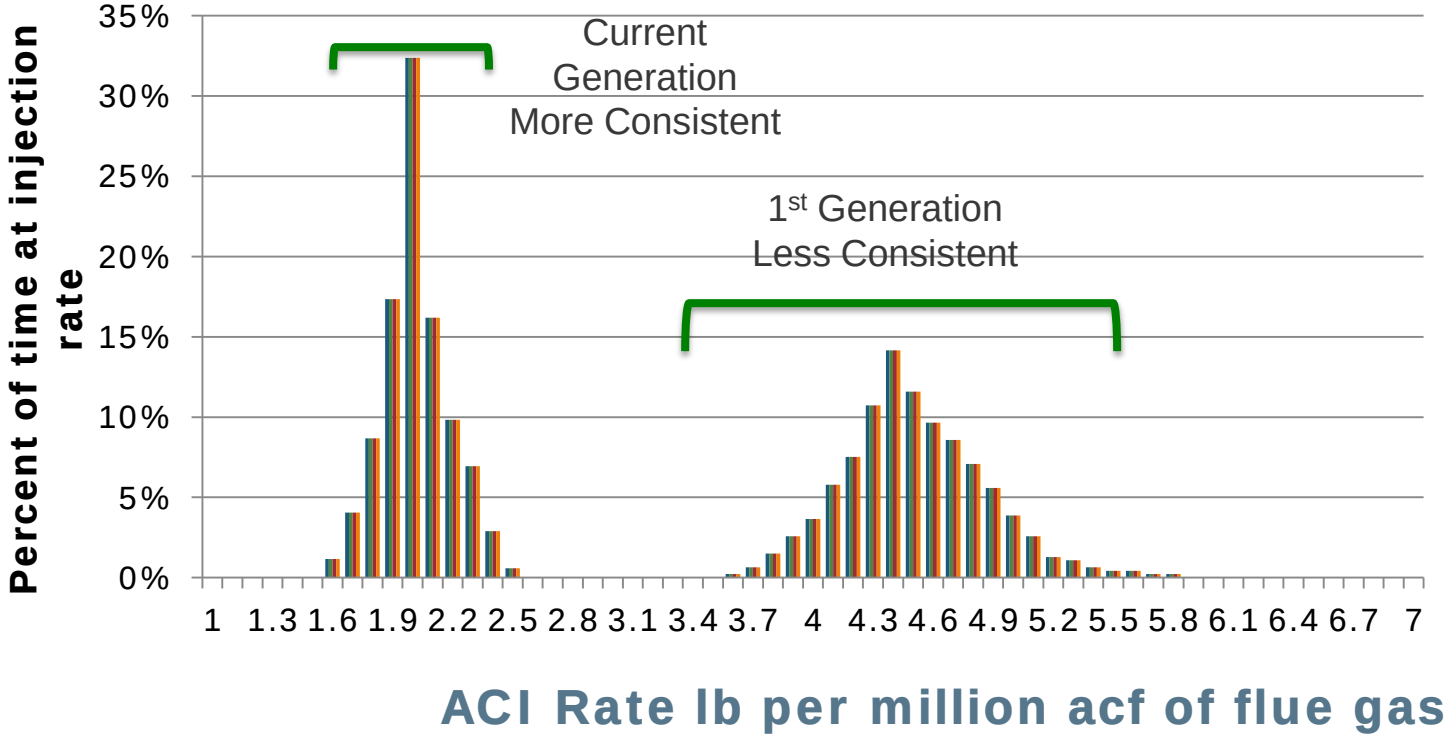
Sorbent Vendors

Top players vying for this $10 billion /year market

Mercury Control:

- Cabot (Norit) – DARCO-Hg family of sorbents
- Calgon – Flue PAC family of sorbents
- ADA carbon Solution: Power PAC, Fast Pac
- Albemarle: B-PAC, C-PAC, H-PAC,
- BASF – Mercury Sorbent HX – Brominated mineral sorbent
- Novinda: Amended Silicates
- EM2C: Additive & PAC
- ADA ES: coal additive, engineering solutions and consulting
- Others: Shaw, Nalco (scrubber additives)

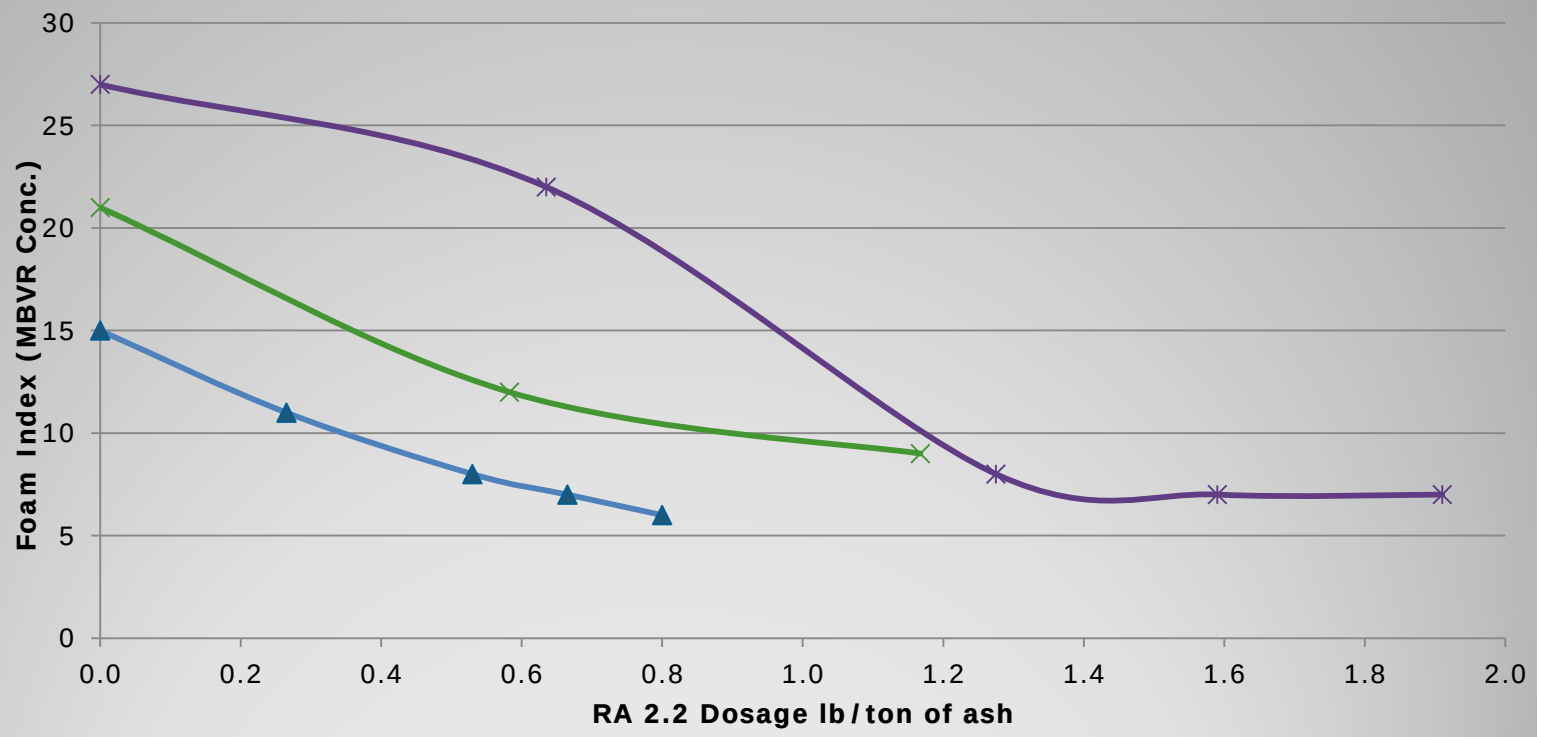
Improvements in Activated Carbon Technology



Lower PAC injection rates and a tighter control range =

less PAC in ash + Improved consistency (AEA demand)

RestoreAir® 2.2 Tamed Dose-Response



Class C ash samples containing variable levels of PAC treated to acceptable foam index level.

Beneficiated ash with **RestoreAir®** 2.2

Sample Description	Control	C-Ash	C-Ash with PAC	
	Cement	No PAC	Untreated	**Treated**
Foam Index (conc MBVR)		***3***	***18***	***5***
AEA dosage (oz/cw)	*1.2*	***1.4***	***4.2***	***1.7***
Air Content (6%±1%)	7.0%	7.0%	6.25%	5.75%
Bulk Density, lb/ft^3	144.8	145.6	147.2	148.0
Slump, inches (6±1)	6.25	6.0	6.25	5.75
3 day, psi	2814	2858	3039	2907
7 day, psi	3433	3689	3592	3918
28 day, psi	**4594**	**4802**	**4764**	**4908**

Ash treatment restored the AEA dosage to same level expected with ash containing NO activated carbon.

Examples of plants in Service Meeting current emissions regs

- Port Neal plant: Ammonia, PAC and Trona
- Newton Power station: PAC
- WoodRiver Plant: PAC

- High Sulfur coal, More class F ash?

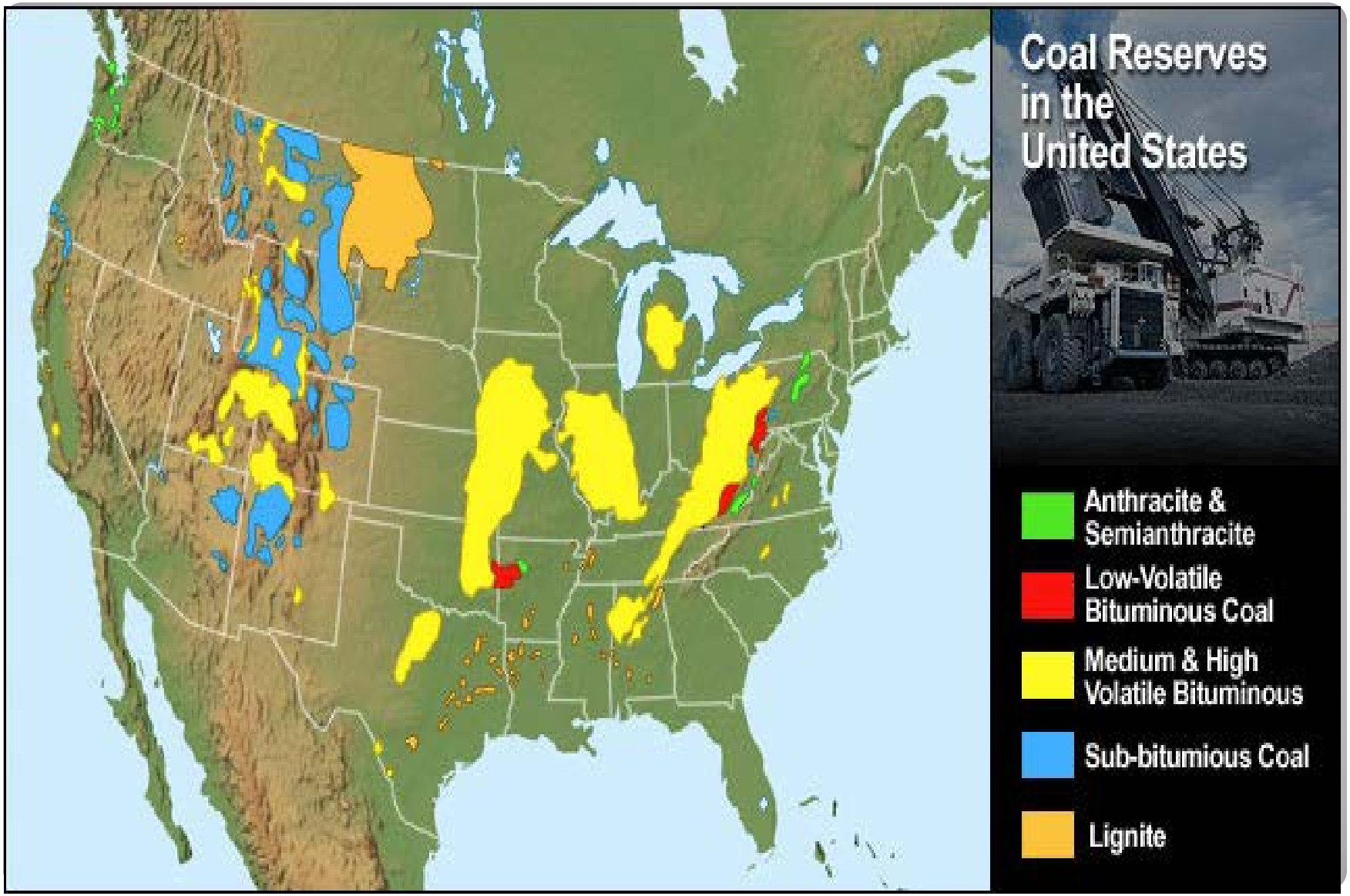
  Dependent on installation of scrubbers

- Blended ash C/F

  Would require mods to state and industry specs.

- Ash from ponds or landfills
- Imported ashes from other countries

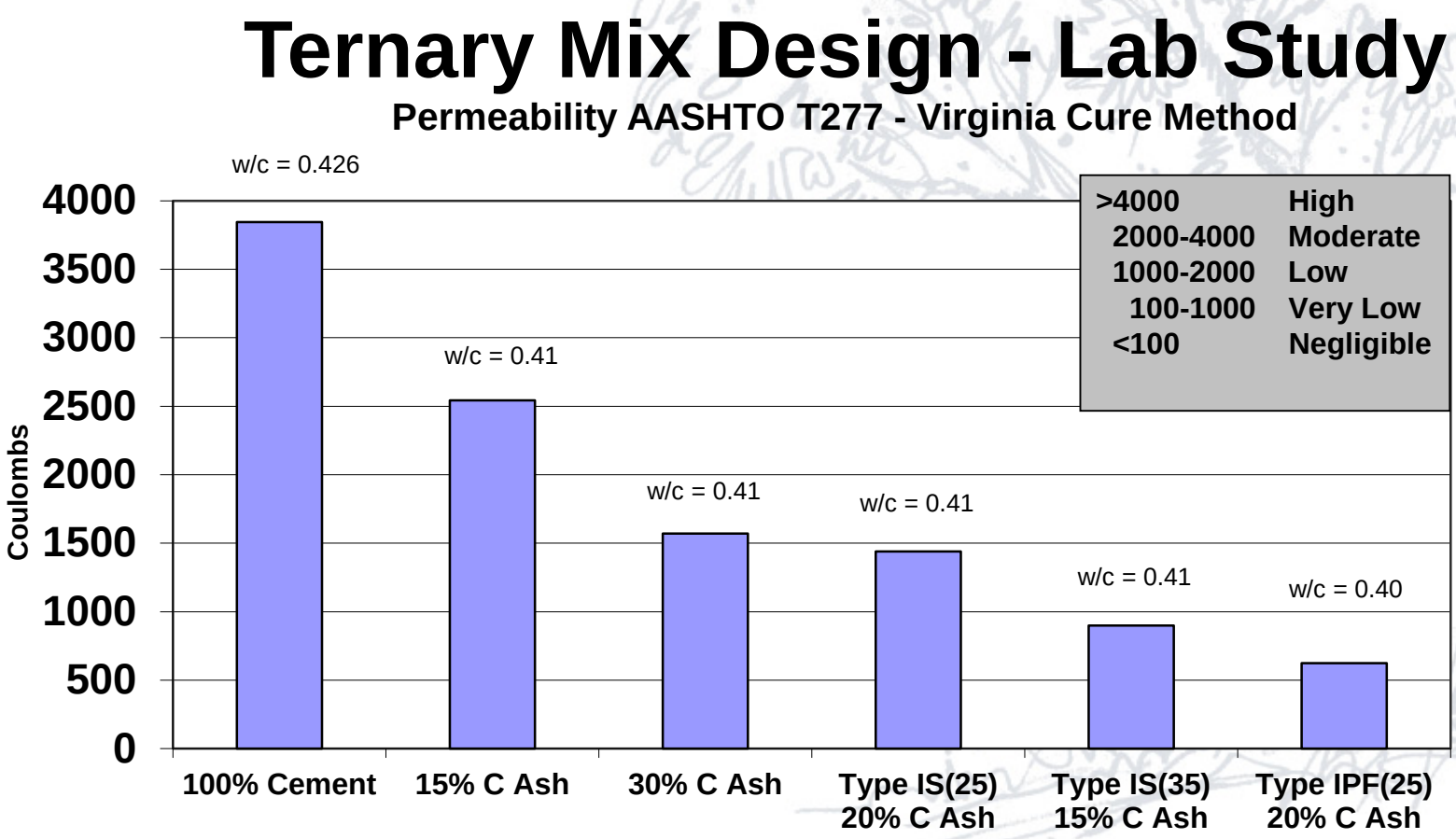
Future opportunities


Coal Reserves in the United States
Anthracite & Semianthracite
Low-Volatile Bituminous Coal
Medium & High Volatile Bituminous
Sub-bitumious Coal
Lignite

Blended Ash C/F

Chemical	Class F	Class C	Class F/Class C	ASTM C 618 Class F Specifications	ASSHTO M295 - 06 Specifications
Silicon Dioxide, SiO2	47.73%	39.32%	42.74%		
Aluminum Oxide, Al2O3	28.19%	19.24%	23.21%		
Iron Oxide, Fe2O3	11.92%	6.22%	9.28%		
Sum SiO_2, Al_2O_3 & Fe_2O_3	87.84%	64.78%	75.23%	70 Min	70 Min
Sulfur Trioxide, SO3	0.32%	1.52%	1.03%	5.0 Max	5.0 Max
Calcium Oxide, CaO	4.02%	23.25%	13.56%		
Sodium Oxide, Na2O	0.66%	1.70%	1.16%		
Magnesium Oxide, MgO	1.44%	5.55%	3.49%		
Potassium Oxide, K2O	2.65%	0.67%	1.64%		
Phosphorus Pentoxide, P2O5	0.68%	1.21%	0.95%		
Titanium Dioxide, TiO2	1.49%	1.33%	1.45%		
Moisture %	0.13	0.106	0.1	3.0 Max	3.0 Max
LOI %	2.13	0.31	1.09	6% Max	5% Max
Physical Analysis					
Fineness %	24.02	25.1	23.76	34% Max	34% Max
Water Requirement % Control	95%	99%	96%	105% Max	105% Max
Specific Gravity gm/cm^3	2.38	2.49	2.42		
Autoclave Expansion %				.8% Max	.8% Max
Strength Activity Index					
With Portland Cement 7 Day	78%	81%	93%	75% Min	75% Min
28 Day	89%	88%	97%	75% Min	75% Min

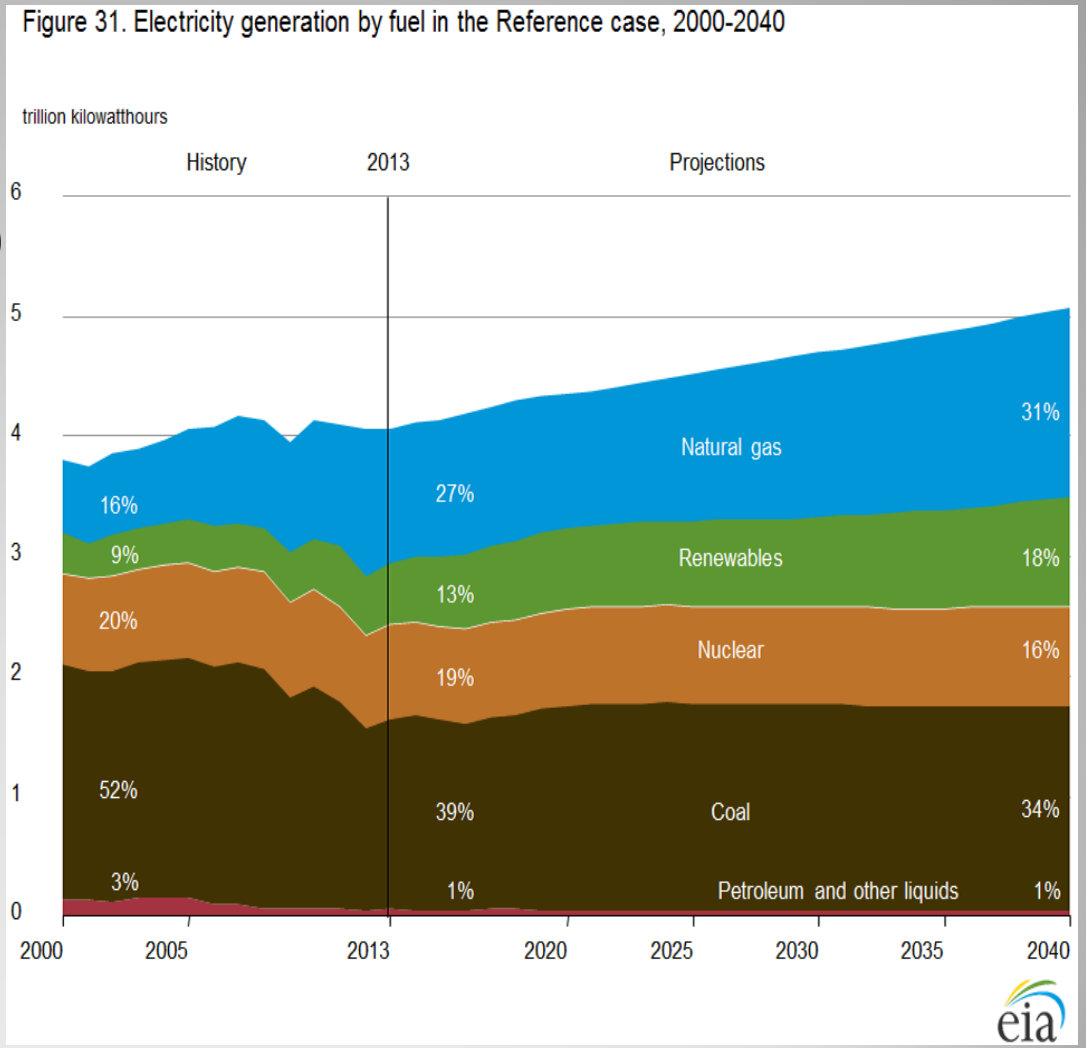
Ternary/Perm Data



- 310 GW coal fired capacity 1990-2010
- 70 GW to be retired by 2025
- 50 GW has yet to occur
- 240 GW are being retrofitted with advanced pollution control systems.

US Coal Fired fleet

- U.S. government forecasts show coal will remain largest energy resource for electricity generation at least through 2040
- Coal's ***share*** of electricity generation continues to decline, but ***volume*** of generation remains stable
- Worst case scenario, 1 Billion tons still to be produced.



Coal Will Remain Largest Electricity Source

SOURCE: U.S. Energy Information Administration, Annual Energy Outlook 2015

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THANKS